"Modeling microphysical effects of entrainment in clouds observed during EUCAARI-IMPACT field campaign"
by Jarecka, Pawlowska, Grabowski and Wyszogrodzki

This manuscript presents a LES modeling study of the turbulent and microphysical properties of clouds, guided by observations made on a specific day during the EUCAARI field campaign. Specific attention is paid to the presence of homogeneous and heterogeneous mixing scenarios, how these are modeled in the LES code, and differ between the two type of clouds observed: stratocumulus and cumulus. The manuscript is well written and the modeling strategy and results are clearly presented, however, it comes across as a report on a rather routine exercise and misses to provide a deeper discussion and insight into the results, so that the reader is left wondering what can be learned from the applied modeling tools and strategy and what new light this study sheds on the topic. My recommendation is therefore Major Revisions, which mainly applies to a rewriting of the document by bringing out the new and interesting aspects of this study.

General comments

If this study holds some unique insight into different mixing scenario's observed in low level clouds, then a more in-depth discussion is needed to highlight this insight. What new light does it shed on the presence of (in)homogeneous mixing and the impact of a scheme that represents stirring? Related questions that should be addressed are:
(i) how do the modeling results compare to observational evidence of (in)homogeneous mixing in shallow cumulus and stratocumulus? The authors do not refer to other observational studies looking at these aspects at the EUCAARI or other campaigns.
(ii) are other LES/advanced microphysical codes (in)capable of showing these results?
(iii) can the discussion of the general results be discussed more concisely, so that more focus can be paid to the discussion of the mixing patterns as simulated with this LES code? In particular section 6, the conclusions of the manuscript, fails to actually provide a discussion or conclusion.
(iv) what part of the modeled behavior of cloud microphysics is a property of the scheme and does (not) comply with observed behavior?

Specific comments

1. P.1492 Line 10/11: The authors write about the homogenization of a gridbox experiencing turbulent mixing. Instead of using the word gridbox, would it be better to talk about a "volume of cloudy air" in general? It is otherwise suggested that all models represent the turbulent stirring accurately.

2. P.1492 Line 25: In the Jarecka et al 10'3 paper, for what case is the delayed evaporation / stirring scheme applied, and can the authors say anything about its functionality and uniqueness?

3. P.1494 Line 5: Is just the height of the aircraft used to distinguish stratocumulus from shallow cumulus, or also the estimated cloud base height? Sometimes shallow cu can reach heights that are within the stratocumulus layer, for instance how do the authors know that the points near 700 m height in Figure 4 are from shallow cumulus and not stratocumulus? And do the heights on the y-axis here also represent height above cloud base, because it does not say so.

4. P.1494 Line 25/26: Here would be a good point to introduce specific questions the authors are interested in to test using the EUCAARI case, e.g. open questions (about model features) left from the

Jarecka 2013 study? Instead of saying that "these observations are compared to results", one could say, "these observations serve as a guideline for".

5. P.1496 Line 1: I have trouble understanding how the mixing scale λ is diagnosed in the model. Although probably outlined in detail in Grabowski et al 2007, it may be worthwhile providing a short statement here.

6. P.1498 Line 15: How are these points that undergo turbulent mixing determined? For instance in Figure 7 many parts of the cloud field are apparently not subject to mixing, is there a threshold set on the diagnosed TKE?

7. P.1498 Line 22-24: Here is a nice point to discuss and describe the structure of the mixing as observed in the Figure. Where and at what heights does one generally find certain values of α, based on existing observations/literature?

8. P.1499 Line 11: Do you need the word CFAD to indicate a frequency distribution? The CFAD term is not broadly used outside of the radar community, so why not just naming it a frequency distribution, with the colors referring to the frequency.

9. P.1499/1500: The end of section 4 goes through Figure by Figure describing typical features of clouds that are commonly known. This reads fairly boring. Can the authors combine the description of what is known and also present in the observations, and outline those features that are particularly interesting and new?

10. P. 1501 Line 15-18: The authors show that the base of the stratocumulus layer behaves much like the top of cumulus clouds, in terms of α. Here would be a good point to discuss what is more surprising to the reader, the behavior at stratocumulus base or at the cumulus top? How much of that behavior is due to the specific formulation of the stirring scheme and the diagnosis of α and the mixing time scales? The important details of Appendix A may be mentioned here to remind the reader.

11. P.1502 Line 2-7: This section is particularly confusing and lacks at providing a clear link between the results and the features of the stirring scheme. The authors write that the droplet radii are very similar in both layers (in Figure 11), but in Figure 14/15 the differences in radii to the power of two are rather different. Line 4: "This is against a common assumption", what does "This" refer to? The diagrams in Figure 14/15 can be explained in more detail e.g. the presence of many (red) points (presumably cloud base) that have a value of 100 for $(1 - RH_d)^{-1}$ and large radii.

12. P.1502: The conclusions are no real conclusions, but rather a summary or repetition from previously written sentences. What news does this study bring? Is it yet common knowledge that mixing in these type of clouds are inhomogeneous? Why are the mixing and evaporation time scales for stratocumulus and cumulus so similar? Is that also observed during the EUCAARI (or other) campaigns?

Typo's/grammar/graphics

- P.1490 Line 5: tropospheric instead of tropspheric
- P.1491 Line 23: "In the homogeneous mixing case," instead of "in the homogeneous mixing, "
- P.1494 Line 11: insert "a" between shows / fairly.

- P.1494 Line 13: insert ”the” between where / FFSSP, and insert ”near” between and / cloud top.
- P.1496 Line 22: ”partly” instead of ”a part”
- P.1496 Line 23: ”explicit diffusion” instead of ”the explicit”
- P.1497 Line 27: here past tense is used (were/was). Consider using present tense consistently throughout the paper.
- P.1501 Line 9-18: much of this is a repetition from what is written earlier and can be made more concise.
- P.1501 Line 11: omit ”the” before ”most of the cloud layer depth, and omit ”of” at the end of the sentence.
- Figure 4: is the y-axis just ”h” or ”h - hcb”. Label should read: ”As in Figure 3, but for the cumulus cloud layer”.
- Figure 6: do you need this FIgure? It is hardly discussed.
- Figure 8: the values of cloud water near the stratocumulus top are 0.35 g/kg, which is less than what is observed. Do you have an explanation for the extra dilution?
- Figure 9-12: do the colors represent fractions or percentages? Indicate.